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others, no difference was remarked when I examined them whilst in the country. The teeth and tusks of the hippopotamus were certainly identical with those of the species now existing in the river.

Similar phenomena were observed on the western shore of Lake Nyassa, which, in shrinking, as proved by elevated sand-beaches, has left clay-flats now crossed by affluent streams. At the mouth of one of these, portions of the frontal bone of an animal and the back of a tortoise were found semifossilised polished and blackened, along with indurated clay nodules, just as on the banks of the Zambesi.

XIII.—*On the Antiquity of the Physical Geography of Inner Africa.* By SIR RODERICK I. MURCHISON, K.C.B., Pres. R.G.S.

Read, April 25, 1864.

WE must all regret that the fossil bones collected by Dr. Livingstone and Dr. Kirk, and which the last-mentioned gentleman has described, should be a remnant only of those remains, and other natural history objects, collected by him. His chief collections having been sent by trading vessels to Mosambique, and, not having yet reached this country, it is feared they may have been lost. The geological maps of Mr. Richard Thornton (excepting one of the Kilima-njaro snowy mountain, which he prepared when he was the companion of Baron C. von der Decken), including those which he was busily occupied in terminating when he died in the Zambesi country, have in like manner been sent away in ships, which have not been heard of, though we may hope that these as well as the collections of Dr. Kirk may still be recovered.

The great interest which attaches to the relics saved by Dr. Kirk is, that though they have been so long entombed in argillaceous drift as to have lost their gelatine, and to have become truly fossil, they all belong to the same species of animals which are still living in South Africa. This, indeed, was the opinion of Dr. Kirk, when he placed these bones at my disposal, as being those of a buffalo, a crocodile, and a water-tortoise. With these were quantities of bones of the various species of antelopes and other animals which now inhabit South Africa, including hippopotami. Prof. Huxley also has at my request examined the vertebræ of the fossil buffalo, and he has identified them with the bones of the living Cape buffalo.

On my own part, I may observe that this discovery strongly supports the theoretical view which I put before this Society in the year 1852,* viz., that Central South Africa had, from the remotest secondary period, or that of the fossil reptile Dicynodon, maintained its undisturbed lacustrine and terrestrial characters up to our own days. I suggested, in short, that what Africa was when the Dicynodon lived would be found to be true in the present day, by our finding a series of lakes and marshes in the centre of the country, the waters of which, occupying plateaux, escaped through fissures in flanking and higher coast ranges of older rocks. I have in subsequent addresses reverted to this view as confirmed by advancing discoveries.

Livingstone demonstrated the truth of this theory as regarded the Zambesi, and it has been well sustained in other regions (particularly in Central Equatorial Africa), by the researches of Burton, Speke, and Grant.

The point to which I specially wish to direct the attention of the Society at present is, that in none of these adventurous journeys in the interior have the travellers met with marine fossiliferous formations, which would indicate that this continent had been submerged, like most other countries, during the secondary, tertiary, or modern periods. Nowhere have they detected limestone with marine organic remains, though I specially urged both Livingstone and Speke in their last journeys to endeavour to discover such rocks. The late lamented Mr. Richard Thornton, the accomplished young geologist who accompanied Livingstone, was moreover particularly charged to look keenly for such reliquiæ, and with all his zeal he found fossil *land* plants of the carboniferous era only.

The only marine shells which have been detected, occur on or near the coasts. Some of these are of Eocene nummulitic age, and others, as at Natal, indicate a very recent elevation of shore deposits. In a letter to myself, Mr. Thornton describes these tertiary rocks as occupying a coast ridge rising to 200 and 300 feet above the sea on the mainland opposite to Zanzibar, from observations which he made when he accompanied Baron von der Decken to Kilima-njaro.

Let it, however, be clearly understood that my view of South Africa applies to the great interior only. For, geologists have long been aware that the Cape Colony has an external fringe of hard ancient marine deposits of palæozoic age, associated with rocks of igneous origin.

That there exists a framework of old rocks is manifest indeed from the excellent geological map of the Cape Colony, by Mr.

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* See "Comparative View of Africa in Primeval and Modern Times," 'Journal of the Royal Geographical Society,' vol. xxii., Pres. Address, p. cxxi.

A. G. Bain, as well as from the explorations of Livingstone, and the observations of Richard Thornton. From Mr. Thornton's journals, copies of which have been placed in my hands, I find that granitic, syenitic, felspathic, and porphyritic rocks of igneous origin, with highly metamorphosed, schistose, and quartzose rocks of great age, occur on the banks of the Zambesi. He also describes near the rapids and falls above Tete various beds of coal in old sandstones, shales, and conglomerates. It is therefore evident that the older or palæozoic rocks of geologists form the nucleus of the continent. At the same time there is no evidence of the existence of any of the younger fossiliferous marine rocks in Inner Africa. My belief is, that the superficial deposits which there exist have been alone formed by disintegration of the old rocks, and that the accumulation of sand, clay, and pebbles, which diversify the surface, are purely of terrestrial or lacustrine or fluviatile origin. This view is indeed to be inferred by simply referring to Mr. Bain's excellent memoir on the geological structure of Southern Africa, which shows that the crystalline and palæozoic rocks were succeeded in the very ancient days of the bidental reptiles, by lacustrine deposits only.*

Whatever rocks have since been examined in the interior and to the north, such as sandstones and clays, often ferruginous, and tufas arising from calcareous springs,—every known feature indicates that terrestrial and fluviatile conditions only prevailed throughout those wide regions and during enormously long periods. The only striking fossil shell, indeed, which Speke found in a ridge at a great distance from the coast, proved to be a large Achatina, similar in form to the *A. perdix* now living in South Africa, and with it was associated a small shell like a Potamides.

The observations of other travellers,—whether made by Livingstone in his first journey across South Africa, between St. Paul de Loanda and the mouth of the Zambesi, or in his recent explorations up the Shiré (in which he was accompanied by Dr. Kirk and his brother Charles Livingstone), when he examined the shores of the Nyassa Lake, or by Burton and Speke, and Speke and Grant, in their respective journeys,—have all equally failed in discovering any inland formation or deposit in which are imbedded fossil marine remains of secondary or tertiary age.

On the contrary, with sandstones, often ferruginous, resting on granites and a very few other rocks, whether quartzose, argillaceous, or tufaceous, all the evidences which have been obtained sustain the validity of my hypothesis of 1852, that the same physical conditions have prevailed in Central Africa from those days when that remarkable fossil reptile of the marsh lived, which was discovered by Mr. Bain in the interior of the Cape Region, and named Dicynodon by Owen, and considered to be a representative in old times of the lacertine associates of the hippopotami of the present day. Again, it is to be specially observed, that the vast interior of the South African continent exhibits no signs of sub-aerial volcanoes, and, consequently its surface has not been diversified by the outpouring of lava streams nor broken up in recent times by any efforts of subterranean heat to escape.* Nor has it been subjected to those great oscillations by which the surfaces of many other countries have, during the glacial period, been so placed under the waters of the ocean as to have been strewed over with erratic blocks and marine exuviæ. For, if South Africa had been beneath the sea during the glacial period, its surface would unquestionably have erratic blocks derived from the high, rocky glacier lands of the Antarctic Pole, just as many low countries of northern Europe were, as geologists know, covered with Arctic and Scandinavian blocks during the same glacial period (see 'Russia in Europe and the Ural Mountains,' pp. 507-556, with map defining the southernmost range of the south of the Scandinavian erratics). But not a single Antarctic or other erratic block has ever been detected in South Africa, even in the colony of the Cape of Good Hope.

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* See 'Transactions of the Geological Society of London,' vol. vii. N.S., p. 178, and Map. See also the admirable papers of Professor Owen in the same volume. The great number of these bidental lizards found by Mr. Bain, and the absence of all marine shells, lead me to believe that the Dicynodon lived as Mr. Bain suggested, in great marshes and lakes which existed in the interior of the country at the close of the old coal-period.

The interior of South Africa may therefore be viewed as a country of very ancient conservative terrestrial character,—a country in which its animals have lived on during a vast length of time undisturbed by those great perturbations which have affected other countries.

It is right to observe, that whilst Dr. Kirk is of opinion that certain small pieces of pottery, which were found with the bones, may be of the same age,† it would require more extended and careful observation to show that these fragments of human manufacture and the fossil bones are coeval, though certainly their appearance favours that opinion.

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* This observation applies to sub-aerial volcanoes only. Rocks of ancient igneous origin are known to occur in the Cape Colony, and elsewhere in the *coast ranges of hard old rocks.* On the east coast the flanking range through which the Zambesi escapes to the sea, rises in altitude from south to north, and attains its greatest height in the snow-capped mountain Kilima-njaro. That mountain being to a great extent composed of trachyte, may have been in igneous action under the atmosphere in a recent geological period. This point, however, has no real bearing on my view of the long continued and undisturbed terrestrial surface of the *interior* of Africa south of the Equator.

† In a letter to myself Dr. Livingstone speaking of these fossil bones says, "The bones were discovered by Dr. Kirk in the upper part of the delta. They were found among gravel, and are probably the remains of animals which lived when the delta began near Mazura. Fragments of pottery were also found amongst the gravel.'

If, however, this point should not be established, yet looking only to the great length of time required to convert bones into a fossil state, we have still every reason to conclude that, in this stable continent, which has through long ages been subjected to atmospheric influences only, the negro type of mankind must be one of very high antiquity. Yet notwithstanding this antiquity, the people of that race have made slight advances in civilization, or in the commonest arts of life, as compared not only with the people of the Caucasian type, but also with those of the Mongolian and Malayan races, or even with the Red Indian and Polynesian races.*

XIV.—*Expedition across the Southern Andes of Chili, with the object of opening a new Line of Communication from the Pacific to the Atlantic Ocean, by the Lake of Nahuel-Huapi and the Rivers Limay and Negro.* By DON GUILLERMO COX, of Chili. (Translated from the Spanish, and communicated by SIR WOODBINE PARISH, K.C.H., F.R.S.)

Read, May 9, 1864.

[THE following paper is extracted from the Diary (in Spanish) of Don Guillermo Cox, a Chilian born, though of British parentage, who, possessed of independent means which enabled him to carry out his object, determined, towards the close of 1862, to make an exploration of the least known parts of the Andes south of Valdivia, in the hope of being able to open a new line of communication across Patagonia between the Pacific and Atlantic Oceans.

The Spanish Government, so long ago as 1782, were desirous to ascertain the practicability of such a route; not from any idea of the benefit which might accrue from it to their own people, but in order to ascertain whether or not, in case of war, any hostile power, and especially the English, by passing up the great River Negro, were likely to be enabled to reach their settlements on the coasts of the Pacific. A competent officer, Don Bazilio Villarino, was ordered to make a careful survey of the whole course of the river in question, and of the passes across the Andes which were supposed to lead direct to Valdivia, from its upper affluents.

Villarino ascended the river, not however without much labour and

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* For an extension of this view of the stationary condition of the negro during a very long period, see my last Anniversary Address, 'Proceedings of the Royal Geographical Society,' vol. viii. p. 248.